(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 788 860 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.08.1997 Bulletin 1997/33

(51) Int. Cl.6: B23P 15/26, F25B 39/02, B23K 1/00, B23K 3/06, B23K 1/08

(21) Application number: 96109398.6

(22) Date of filing: 12.06.1996

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE LI LU MC NL PT SE

(30) Priority: 07.02.1996 IT UD960013

(71) Applicant:
C.G.A. COMPAGNIA GENERALE ALLUMINIO S. p.A.
I-33043 Cividale del Friuli (IT)

(72) Inventor: Nocivelli, Gianfranco
33043 Cividale del Friuli (UD) (IT)

(74) Representative: D'Agostini, Giovanni, Dr.
D'AGOSTINI ORGANIZZAZIONE
Via G. Giusti 17
33100 Udine (IT)

(54) Heat exchange assembly and relative process and production plant

(57) Heat exchange assembly and relative process and production plant, of the type in which it is used:

- a plate evaporator (1), with evaporation duct (1'-1"-1"') obtained between two metallic metal-sheets welded one with the other, that with an outward duct (A) and a return duct (R) debouches into a mouth collector coupling sleeve(12) in a corresponding junction area (13');
- a freezing circuit coaxial tubular system (3,4,5), having an external return tube (3) and an internal delivery capillary tubule (5), in which said capillary tubule (5) protrudes over said return tube end (3), where said tubular system is mouthed within said mouth collector coupling sleeve (12) of the evaporator (1), while said capillary tubule (5) debouches freely and is there clamped (11) within said delivery duct branch (1') of said evaporator (1) obtruding the non-return external passage, having the characteristic of avoiding the traditional welding operation allowing a substantially automatized production.

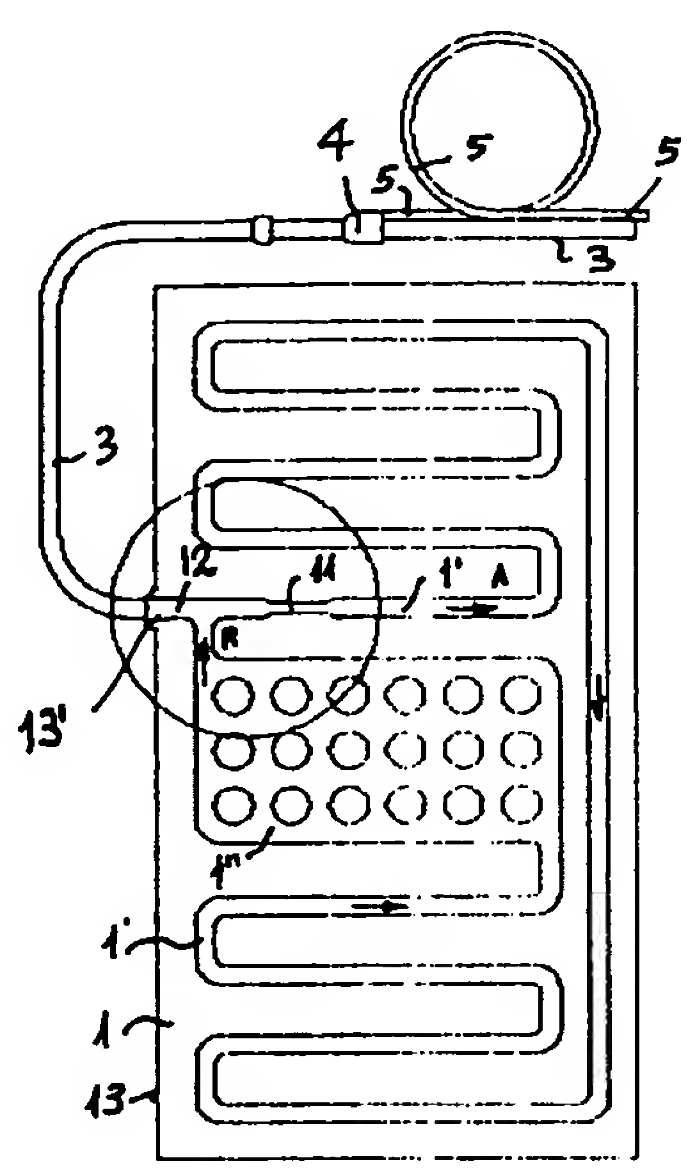

FIG. 1

EP 0 788 860 A1

Description

The present invention has for object an heat exchange assembly and relative process and production plant.

The invention finds particular even if not exclusive application in the industrial and domestic refrigerators as for example the evaporators and their component parts.

In prior art it is known that the main component of the freezing circuit refrigerator is the evaporator, that is a part of the circuit in which the cooling fluid (Eg. freon, iso-butane R600, R134A, and other equivalent fluids) expands. The freezing fluid is first compressed by a compressor and after having passed through an external heat exchanger acting as condenser, it is sent into said evaporator by a capillary tube.

The capillary tube generally conveys the compressed cooling fluid practically in a liquid form to the evaporator. This fluid, coming out free in the evaporator expands and becomes gaseous subtracting calories and therefore cooling the surrounding area.

This is due to the known law of fluid mechanics PV=RT=constant , where P indicates the pressure of the fluid, V indicates its volume, T indicates the absolute temperature =-273 C° and R is a constant.

On the base of the aforementioned formula it is therefore known that for reducing the pressure the volume must be increased or viceversa, that is said compressed cooling fluid that comes out from the capillary tubule must be let free to expand and in this way the cooling is obtained.

This expansion takes place on the inside of a duct made in said evaporator whose name comes from the fact that when the cooling fluid is compressed in the capillary it is substantially liquid and when comes out of it, because of its free expansion, vaporizes immediately and expands subtracting heat to the evaporator walls that for such reason cool the surrounding environment of the refrigerating box.

The cooling fluid circulates therefore freely in the evaporator and then is re-sucked by the compressor by means of a return duct .

By means of the compressor, that is external to the refrigerator box, the gaseous cooling fluid is compressed again.

The compression involves a considerable increase of the cooling fluid temperature, wherefore it is forced to pass by previous passing to a finned coil tubular condenser, placed on the outside of the refrigerating box, generally on the back side of the refrigerator.

The finned condenser yields heat to the environment air and cools, the cooling causes the condensation of the compressed gas, making it liquefy, for such reason this external heat exchanger is called condenser.

The compressed liquid cooling fluid, then passes into a tubule having very short diameter that is called capillary tube, which as mentioned debouches into the evaporator.

The cycle is repeated with closed circuit and the cooling continues.

For reducing the costs of the cooling circuit, it is generally used a single coaxial duct, that is:

a return tube of the cooling fluid in gaseous form from the evaporator (which has an internal diameter substantially wider than the external diameter of said capillary tube), and
said capillary tube (having a very small diameter if compared to the first one), coming directly from the condenser, that is internally connected into the return tube and the assembly is sent to the evaporator which is placed inside the refrigerator box.

The reasons for including said capillary tube, within the return tube, are thus suggested:

- both for efficiency reasons for furtherly cooling the capillary with the return cooling fluid coming still cold from the evaporator;
- and for economy technological constructive reasons as with such system only one tube must be welded to the evaporator.

For obtaining this result though it is necessary to obtain an absolutely airtight closed circuit, not in contact with the air and without leaks, wherefore, the evaporator has a circuit also closed only on one single mouth as a collector, where it is directly "Y" branched with an outward duct, generally rectilinear respect to the mouth shaped as collector coupling sleeve, and a return duct, generally at 90 degrees respect to the first one and in proximity of said mouth, where it will be fitted and will be provided for the welding of the coaxial pipe that leads to the condenser and compressor.

The welding of said coaxial tube takes place so that:

the external return tube is immediately welded at the entry, within the respective mouth collector coupling sleeve, allowing the free connection with the evaporator return duct, while
the capillary tubule extends over said return duct until it connects into said evaporator outward duct.

Between the outside of the capillary tubule and the inside of the outward duct there must be no communication, otherwise the closed circuit would not be obtained, wherefore the connection is carried out in the following phases:

. the part around the end of the capillary tube must be filled with a sealing paste;
. the return tube must be engaged with the respective projecting capillary tube, within the mouth in the coupling sleeve of the evaporator collector, so that the paste of the capillary end goes to obstruct the

part around the delivery branch;

- a first section of the outward branch of the evaporator must be caulked, that is it must be squeezed so that this squeezing, together with said sealing paste, obstructs completely the aback opening of the external part of said capillary tube (in this way the capillary tube will directly debouche only into the outward duct of the evaporator and the cooling fluid will be able to expand only within said outward duct as evaporation duct).

The cooling fluid is forced to flow along all the circuit provided in the evaporator (circuit that provides a considerable volume increase) and will return back after having flown through all the circuit of the evaporator, through the return duct annularly entering on the outside of said capillary tubule and on the inside of said return tube.

the outside of said return tube must be welded on said coupling sleeve of the collector mouth duct, by braze welding or by weld material in inert gas (system T.I.G.), in order to have a perfect sealing.

Advantageously, the evaporator is made:

Long ago by a welding which joined two aluminium sheets having an alloy sheet interposed and subjected to temperature; at least one of those sheets was pre-shaped for supplying between each other the wished freezing circuit for the cooling fluid evaporation .

In the prior art, the evaporator plate is made by coupling, by means of a rolling process, two or more layers of aluminium alloy strips according to the "Roll Bond" technique. Correspondingly to the internal surfaces of the layers it is obtained, by silk-screen processing, the circuit that will receive the refrigerating fluid and that, practically, represents in the rolling phase a solution of continuity among the layers allowing their detachment at the desired height, by means of a following inflating action.

As said, the piping of the freezing circuit is an assembly of a connecting tube between the evaporator and the rest of the refrigerating circuit and may be made in aluminium and copper with a bimetallic junction of the traditional type (resistance or flash made) and a coaxial capillary that acts as rolling valve for the cooling fluid.

The above mentioned operation is extremely complex and expensive.

In particular it was noticed that complexity and costs are substantially due to the last brazing or welding phase where weld material in inert environment is used.

In fact due to the complexity of the system, this welding operation cannot be carried out mechanically or automatically, but only manually, and in particular it is not even possible a low cost robotization.

The cause thereof is due to the continuous changing of evaporator shapes and of the coupling positions of the freezing circuit coaxial tube.

At the beginning were used brazing systems which used an alloy with very high silver content (therefore extremely expensive) with a manual quill traditional system.

This technique of using silver alloys was required:

- both for the need of maintaining the brazing temperature low;
- and for making possible a maximum penetration for the capillarity principle, of the melted alloy in the interstice or interspace between the outside of the return tube and the mouth collector coupling sleeve of the evaporator.

When expensive high quality alloys in silver, copper, zinc, and other metals were not used, the results obtained from the welding were poor:

both for the need of increasing the welding temperature with an easy deoxidant evaporation and therefore an easy formation of aluminium oxide that as a matter of fact prevented the welding of metals; and for the alloy reduced fluidity.

Nowadays it is generally used an electric arc welding with tungsten electrodes and inert gas weld material known as T.I.G. system (Tungsten Inert Gas).

But also this solution has high qualitative limits, particularly for its manuality that involves changes and therefore a defective welding risk, for example in the oxidation of the surfaces to be welded or in the incomplete accuracy during the welding process.

These operations, must be carried out manually by a single operator, and this prevents a mechanization at acceptable costs.

The system is also dangerous because it forces the operator to work in presence of electromagnetic waves and in a toxic environment, wherefore requires the use of screening elements and the presence of suitable ventilation and suction systems.

A further problem derives additionally from that, as it is known, the welding areas, have always chemical-physical-mechanical characteristics different if compared to the two welded elements.

In fact the welding areas are known

as possible areas for corrosions and crackings This is taught not only by technique but also and above all by experience. See for example the technique of the aeronautical constructions where nowadays riveting is still used for joining the light alloy elements (metal-sheets) in place of welding.

This is obvious particularly in the case of continuous dynamic stresses, that can exactly cause cracks and fissures which bring to a final breakage.

Now it is known that even if indirectly also said coaxial tube is subjected to continuous vibrations exerted by the compressor, that somehow are transmit-

ted, even if reduced, also to the welding area and to the evaporator, with breakage risks in the long run.

Laboratory tests in such field have widely demonstrated what stated above.

The weldings must be made with great accuracy and the welding area must be very enlarged with a considerable amount of weld material, this involves not only a material consumption beyond what is strictly necessary for the welding itself, but also a worsening of the aesthetic aspect.

Also the eventual external cleaning of the same welding is expensive.

Purpose of the present invention

The purpose of this invention is to avoid the abovementioned drawbacks and make possible:

not only the full mechanizing of the evaporators production, getting over the manual welding problems explained above,
but also the supplying of a product with better qualities and performance, that is regarding the whole product or at least the area that involves said welding;
and this with possibly lower costs.

This and other purposes are obtained as claimed by means of a new process for the production of heat exchangers and their parts, of the type in which pipes are used, in which it is provided at least one male and female connector for assembling one or more parts of the exchanger circuit, characterised in that it is carried out as follows:

said connectors have a tagging or final coupling connection such to make adhere the end surface of the respective male part respect to the internal surface of the female part, to prevent the substantial passing of the melted metal over said connection;
it is used a tank with melted metal bath compatible for binding closely with the metallic material that makes up the assembly,
after having carried out the connections for obtaining an assembly or pre-assembly, the evaporator group thus pre-assembled or at least the connection zones are heated at a temperature lower than the melting and in any case deformation temperature of said pre-assembly,
said assembly or pre-assembly is immerged, fully or at least for the part concerned with the junction area of said connections, in said melted metal bath, having a fluidity and capillarity index such to allow, in function of the temperature, to penetrate in the interspace between the male and female elements of said connections,
said evaporator group is taken out from said bath for the respective cooling.

Advantages of the invention

In this way the production system may be fully mechanized because said assembly or pre-assembly as for example the evaporators groups can be conveyed in continuous advancing or pitch line, therefore in continuous cycle.

And the above mentioned occurring in a fully automatic way without need for operators, being the shape of the evaporator or the position or width or shape and number of the connections independent.

Furthermore, in this way in one single operation are provided all the weldings, also of more connections, simultaneously.

The costs are therefore sensitively reduced.

The resulting advantages are enormous and such to fully justify the very important technological innovation, that even using technologically widely known knowledges, is able to combine them in way up to now unthought with immediate consequences both on the qualitative production and cost and security having no more need for manpower.

In other words the metal bath replaces the necessity for welding or brazing, as the connections are closely blocked by melted metal penetration within them, which provides a similar and even better performance.

In fact said metallic bath, not only allows the metal to penetrate by capillarity among the male and female elements of the connections, but also forms an external protection superficial coating layer.

In fact it is known that in case of bi-metallic pipes (part of the pipe in aluminium and part in copper), are generated some galvanic currents that cause corrosion. The passivation therefore provides not only the advantage of the superficial protection against the wear but also a suitable protection against corrosion.

The evaporator then will be easily be subjected to further varnishing, with the advantage that at least in the welding area (or in all the evaporator if fully immerged in the metallic bath) will have a double protective layer against wear and oxidation-corrosion.

Advantageously the evaporator utilized and said return tube are in aluminium or aluminium alloy and said melted metal is a substantially zinc and aluminium alloy.

The alloy includes 95% Zinc more or less 5% and Aluminium giving both fluidity and compatibility at a low suitable temperature.

And the heating of the melted bath happens preferably on the inside of a distance between 420 and 460° C, where the alloy has an optimal fluidity.

In this way a very strong bond and penetration of the metal is obtained for blocking the male-female connectors junctions.

As much advantageously said evaporator group is preheated before of the immersion in said melted metal bath, to a temperature at least 10-15 °C higher respect to the bath temperature. In this way it is ensured a maximum penetration capillarity of the metal between said

mouth collector coupling sleeve and the return tube.

As much advantageously, to avoid the danger of hindering the amalgamation of the melted metal with the internal surface of the mouth collector coupling sleeve and the external surface of said return tube, said melted metal is subjected to ultrasounds, so that the ultrasonic vibrations, favour the detachment of the oxide coating from the bathed surfaces, allowing a better close contact.

Advantageously the bath will have a vertical axial direction.

In this way there is not only the advantage of bathing the junction area that advantageously may be projecting, but there will also be the advantage of allowing the oxides present in the interspace junction of coupling sleeve and mouth collector of the return tube, to detach by floating or be pushed towards the above tube-beat annular bottom in the collector, favouring also an obstruction of said interspace and preventing the metal to pass on the inside of the outward and return ducts of the evaporator.

Furthermore the oxides that detach externally in the metallic bath can be skimmed because floating periodically from said bath, being thus able to fully utilize the melted metal with a minimum loss.

As by taking the evaporator group out of the bath it may occur a metal dripping that will cool on the surface leaving the spatter, this can be avoided by a suitable air jet.

These and other advantages will appear by the following description of a preferred embodiment solution with the help of the enclosed drawings whose details are not to be considered limitative but only supplied as an example.

Figure 1 is a view of the pre-assembled evaporator group .

Figure 2 is an enlarged partial section view of the junction area within said mouth coupling sleeve of the freezing circuit pipe with the evaporator.

Figure 3 is a schematic view of the possible mechanization of the evaporator group production plant, in the phase where the pipe of the freezing circuit is fixed in the evaporator plate, in which it is shown that both connections (pipe-pipe and pipe-evaporator) are immerged in the bath and therefore simultaneously sealed, that is welded by the melted bath.

Figure 4 represents again the junction area schematically enlarged.

Figure 5 is a schematic sectional view of the connection area in the pipe of the freezing circuit in correspondence of the branch with the capillary tube coming out.

Figure 6 represents a section schematic plan view of the connection of Fig.5.

Figure 7 represents a section schematic plan view of the connection of Fig.5, as variation of the solution of Fig.6, in the configuration of the return tube male end portion, by undulation that forms some grooves in the connection area that favour the penetration of the melted material (obviously said undulations or grooves could be alternatively made in the female part, that is in the external coupling sleeve).

With reference to the Figures it can be noticed that on 1 is shown the evaporator plate, which, as said is obtained by the junction of two metal-sheets shaped in order to form a single assembly (roll bond) with the evaporation circuit 1' that branches from a mouth collector coupling sleeve 12 which has an outgoing "A" and a return (R-1''') after full expansion in a large evaporation surface (1'').

To the evaporator plate is connected in said mouth collector coupling sleeve said freezing circuit pipe that includes a return tube 3 and a capillary tubule 5 which is placed inside of the return tube 3, and projects from it, for proceeding within the evaporator delivery duct 1', where it is clamped by the caulking 11 of the outward duct that forms by means of a sealing paste a sealing around the capillary tube, allowing the outflow only in the outward duct.

The return tube 3 is fully fitted in said coupling sleeve 12 where it connects in close contact, allowing the outflow of the cooling fluid gas annularly outside of the capillary tube (5) and inside of the return tube 3.

At a certain distance in length of the return tube 3+ capillary tube 5 pipe, there is a welding knot, generally glass-like (4), where the two tubes are disjoined (3) and (5) to be, when assembled in the refrigerator box, brought externally to the refrigerating cell .

The evaporator plate is generally rectangular and is supplied flat or slightly pre-bent to the refrigerators industry to ease the complete bending.

The pipe 3+5 welded to the evaporator is conveniently put alongside to the evaporator plate and the free capillary is rolled up, as clearly shown in figures 1 and 3.

This is obviously done for technical reasons of encumbrances reduction, in order to ease the moving and packing.

According to the invention, on a continuous conveyor "C" are hung the pre-assembled evaporator groups E (1+3+5) as from Fig.1.

These evaporators are first forced to pass in a preheating station (for example heating tunnel "T") where is preheated the junction area 13' that suitably projects respect to the lower board of the evaporator plate 13.

The heating takes place at a temperature at least 10-15° higher if compared to the Aluminium-zinc metallic alloy bath (B).

After the pre-heating, the conveyor (C) conveys the evaporator group (E) directly in partial or total immersion within the melted metal bath (B).

The running continues and the evaporator comes out of the bath. An air jet not shown will take the metal drops and favour a quick solidification.

At this point the evaporator group is ready to be conveyed to the final assembly for obtaining the refrigerator without further processings, or it will be conveyed to a following varnishing station.

Advantageously as said:

- during the immersion the assembly will be subjected to ultrasonic vibration.

In this way, the surface oxide will flake and will tend to float on the bath favouring the deep adherence of the metallic alloy both on the surface of the evaporator and on the surface of the pipe concerned.

Periodically the slag floating on the bath (B) will be removed by skimming.

As the coupling sleeve-like junction will be vertically placed downwards, the oxide slag will be thrust upwards by the pressure of the melted metal, and will annularly accumulate along the coupling narrowing (6) supplying a natural plug against the danger that the melted metal transude within the delivery and return ducts inside of the evaporator.

In the figure the junction area (13") has been created projecting respect to the lower edge (13), but it is also possible not to have this projecting element 13' and that one part of the evaporator or even the entire evaporator is immerged in order to supply a further protection coating (operation much more expensive but that would supply an evaporator with a higher resistance to corrosion and wear).

The junction area may also be displaced on a corner of the evaporator and this one in such a case will be hung diagonallly tilted, so that protusions will not be necessary and the immerged part can be minimum.

Obviously the pipe may be of aluminium and its alloys or of copper and its alloys. In fact the coating due to the metallic bath involves a passivation of the connection subjected to galvanic corrosion, particularly more dangerous when there are different metals (ie. Aluminium with Copper).

Also the respective branch 4 can be subjected to said bath giving also in it the same sealing by using the same technique of what described above.

In such a case the immersion of Fig.3, shall provide that also the branch portion (4) is immerged, prearranging the pipe alongside the evaporator plate in a different way, or also immerging more the whole evaporator group.

In Figure 7 is shown a convenient variation to the connection, by shaping the return tube (3 and 3') internal to the coupling sleeve (4). This favours the penetration of the melted alloy.

The solution of figure 5 represents the connection of two return tubes 3 and 3' with the outgoing of the capillary tube 5, the whole encapsulated by the glass-like coupling sleeve 4. Thus the return tube 3 is in aluminium and its protrusion 3' is conveniently in copper.

It is any way clear that only one return tube 3 entirely in aluminium can be used, with lateral hole for the outgoing of the capillary tube (5), the whole encapsulated by the glass-like coupling sleeve (4).

Alternatively the coupling sleeve 4 could also be eliminated and obtained by shaping by the widening of the evaporator return tube mouth (3) and by inserting in it the return extension (3'), thus the coupling sleeve (4) would be integral part of the first return tube section (3).

Advantageously to favour the penetration of the melted metal within said collector coupling sleeve, a lateral holing on said collector coupling sleeve may be provided.

In such case this breathing will favour the penetration of the metal, said breathing being able to have such a value that it automatically obstructs at the extraction from said bath by capillarity and following solidification.

The use of the ultrasonic technology for the assembling of the evaporator group, involves, besides a reduction of the number of connecting points, also the possibility to avoid using deoxidizing substances with the consequent certainty of the internal cleanness of the circuit and with a general improvement of the environmental operative conditions.

The project and the geometric preparation of the connection before prearranging the plant, will guarantee repetitiveness.

The realization of an interlocking system made up of a numerical control rototranslator, allows to obtain an in- process indirect control on the steadiness of the characteristics.

Additionally the same ultrasonic welding typology allows to determine priorly the process parameters and ensure with their steadiness the repetition of the result making it independent from the operator's ability.

The geometry of the junction on the panel is predetermined by a tool able to create the suitable seat for receiving the exchanger tube and preventing the possible obstruction of the connection.

The processing steps:

The first phase consists in connecting the pipe end of the freezing circuit within the mouth collector coupling sleeve (whose seat will be pre-calibrated) of the evaporator plate, by inserting the first one inside of a pre-calibrated seat.

The second phase provides the pre-heating of the panel-pipe assembly of the freezing circuit at a temperature 10-15° C higher than the melting point of the welding alloy.

The third phase consists in immerging the pre-heated assembly into a Zinc and Aluminium melted alloy bath.

After some seconds during which the exchanger tube -panel assembly adapts in the alloy, the action of the ultrasounds begins subjecting the whole assembly to molecular vibrations.

The cavitation brought by the ultrasonic excitation of the melted alloy removes the oxides from the submerged metallic surfaces favouring the amalgamation of the melted alloy with the melted metal.

The combination between the main pressure of the liquid alloy caused by the joining of the assembly that is immerged in melted alloy and the ultrasonic vibration makes the alloy penetrate and fill the cavities between the two parts to be joined, pushing the oxide upwards.

Part of the oxides dissipate into the melted alloy, and subsequently will float on surface, from where will be easily removed.

When they are out of the bath a cleaning phase and control may be provided with possible removal of the alloy residues and the following functional test.

the pipe of the freezing circuit can be sealed in the same phase or even in preventive phase as far as concerns the deviation knot 4 with similar technique.

Claims

1. Process for the production of heat exchangers, of the type in which for the making of the exchanger is used an assembly or pre-assembly having at least one connection (5-3-12-13' / 3'-3-4-5) for assembling one or more parts of the male and female exchanger circuit (3-4-5), characterised in proceeding as follows:

    said male and female connectors (5-3-12-13' / 3'-3-4-5) are structured with a tagging or final coupling connection such to bring in adherence the end surface of the respective male part (3-3' / 5) respect to the internal surface of the female part (4 / 12), to prevent the substantial passing of the melted metal beyond said connection;
    it is utilized a tank with melted metal bath (B) suitable for binding closely with the metallic material which forms the metal parts of the elements to be joined,
    after having made the connections to obtain at least one assembly or pre-assembly, the assembly thus pre-assembled or at least the connection area/s concerned (4, 13') is heated at a temperature substantially lower than the melting temperature and in any way of deformation of said assembly or pre-assembly, and
    said assembly or pre-assembly is immerged, fully or at least for the part concerning the junction area of said connection/s, in said melted metal bath, having a fluidity and a capillarity index such to allow, in function of temperature and capillarity index, to penetrate in the interspace among the male (3-3' / 5) and female (4 / 12) of said connection/s,
    said assembly or pre-assembly is taken out of said bath for the respective cooling.

2. Process according to claim 1., characterised in that during said immersion (E-B) said melted metal bath is subjected to vibration action.

3. Process according to claim 1., characterised in that during said immersion (E-B) said melted metal bath is subjected to vibration action by ultrasounds.

4. Process according to the previous claims, characterised in that when it comes out of said bath (B) the part of said assembly or pre-assembly concerned with the bath (E) is subjected to an air jet.

5. Process according to any one of the previous claims, characterised in that said pre-heating phase consists in bringing said assembly or pre-assembly (E) or its part concerned with the bath, to a temperature of 10-15 ° Centigrades higher than the temperature of said bath (B).

6. Process according to the previous claims, characterised in that the male part or the female part of said connection provides longitudinal grooves (N) to ease the penetration of the melted metal in said bath (B).

7. Process according to the pervious claims, characterised in that the female part of said connection provides at least one transversal holing to ease the penetration of the melted metal in said bath (B).

8. Process according to the previous claims, characterised in that said melted metal in said bath contains aluminium.

9. Process according to the previous claims, characterised in that said melted metal in said bath contains zinc.

10. Process according to the previous claims, characterised in that said melted metal in said bath is a zinc-aluminium based alloy.

11. Process according to the previous claims, characterised in that said melted metal in said bath is a substantially 95% zinc and 5% aluminium based alloy and the bath is brought to a temperature around 435°C.

12. Process according to any one of the previous claims, characterised in that said pre-assembly is an heat exchange circuit pipe (3,4,5).

13. Process according to any one of the previous claims, characterised in that said assembly is an evaporator group (1,2,3,4,5).

14. Process according to any one of the previous claims, characterised in that said assembly is an evaporator group (1,2,3,4,5) in which simultaneously all the respective connections are sealed (2,3) in a single immersion phase.

15. Plant for the production of heat exchangers according to the process as in previous claims, characterised in that it comprises at least one melted metal tank (B) for immerging at least in part a pre-assembled evaporator group with the pre-assembled parts

not welded.

16. Plant according to claim 12, characterised in that said melted metal tank (B) contains a zinc-aluminium alloy.

17. Plant according to claim 12, characterised in that said melted metal tank (B) contains a zinc-aluminium alloy with about 95% zinc.

18. Plant according to claim 12, characterised in that said melted metal tank (B) is connected to a vibratory apparatus for the melted metal.

19. Plant according to claim 12, characterised in that said melted metal tank (B) is connected to a vibratory apparatus for the melted metal by ultrasounds.

20. Plant according to the previous claims, characterised in that at the beginning of said melted metal tank (B) is installed a pre-heating system (T) of said pre-assembled groups (E) for heating at least their connection junction parts (4,13').

21. Plant according to the previous claims, characterised in that said pre-assembled groups (E) are hung and placed in advancement on continuous conveyor (C), which provides:

- a tunnel or preheating station (T) and immediately at the beginning of said tank (B) and
- over said tank (B) a lowering of the conveying advancement line (C) for the automatic immersion at least partial, during the advancement of said pre-assembled / assembled groups.

22. Plant according to the previous claims, characterised in that it provides on the inside in exit from said bath (B) air jets to be directed over the wet surface of said evaporators groups (E).

23. Evaporator group obtained by the process according to the previuos claims, of the type that includes an evaporator plate in aluminium or its alloys, to which it is connected in a corresponding junction area (1"), a metallic pipe (3) of freezing circuit (3,4,5), in a corresponding mouth collector coupling sleeve (12) of the evaporation circuit (1',1",1"') of said evaporator (1), characterised in that:

- the external surface at least of said junction area is covered by a melted metal layer made adherent by immersion;
- the interspace of said connection (3-12) is sealed by penetration of the same melted metal that coats the surrounding external area.

24. Evaporator group obtained by the process according to the previous claims, characterised in that said junction area is projecting (13') respect to the edge (13) of the evaporator plate (1).

25. Evaporator group according to the claims 21,22 characterised in that said junction area (13') is placed in a corner of the evaporator plate (1).

26. Evaporator group obtained by the process according to the previous claims, characterised in being entirely coated by a melted metal protection layer made adherent by immersion (B).

27. Evaporator group obtained by the process according to the previous claims, characterised in that it comprises a second connection (4) of said pipe of the freezing circuit (3-3'-5), which, intended for making the respective capillary tube come out (5) from said return tube (3), is also sealed and coated by immersion in said melted metal bath (B).

28. Evaporator group obtained by the process according to the previous claims, characterised in that the freezing circuit pipe (3-3'-4-5), provides the use of only one metallic material such as Aluminium or Aluminium alloy substantially of the same material of the evaporator.

29. Evaporator group obtained by the process according to the previous claims, characterised in that the coupling sleeve (4) of a second connection (3-3'-4-5), is eliminated and replaced with the respective sleeve-like enlargement of the respective evaporator return tube (3).

30. Evaporator group obtained by the process according to the previous claims, characterised in that said connections provide a shaping of the male or female part with grooves (N).

31. Evaporator group obtained by the process according to the previous claims, characterised in that said exchanger circuit pipe (3-3'-4-5), provides the use only of one integral return tube (3-3'), without junctions, that uses a glass-like coupling sleeve (4) that allows said capillary tube to come out (5) of said return tube, encapsulating it and filled out with melted metal in said bath (B).

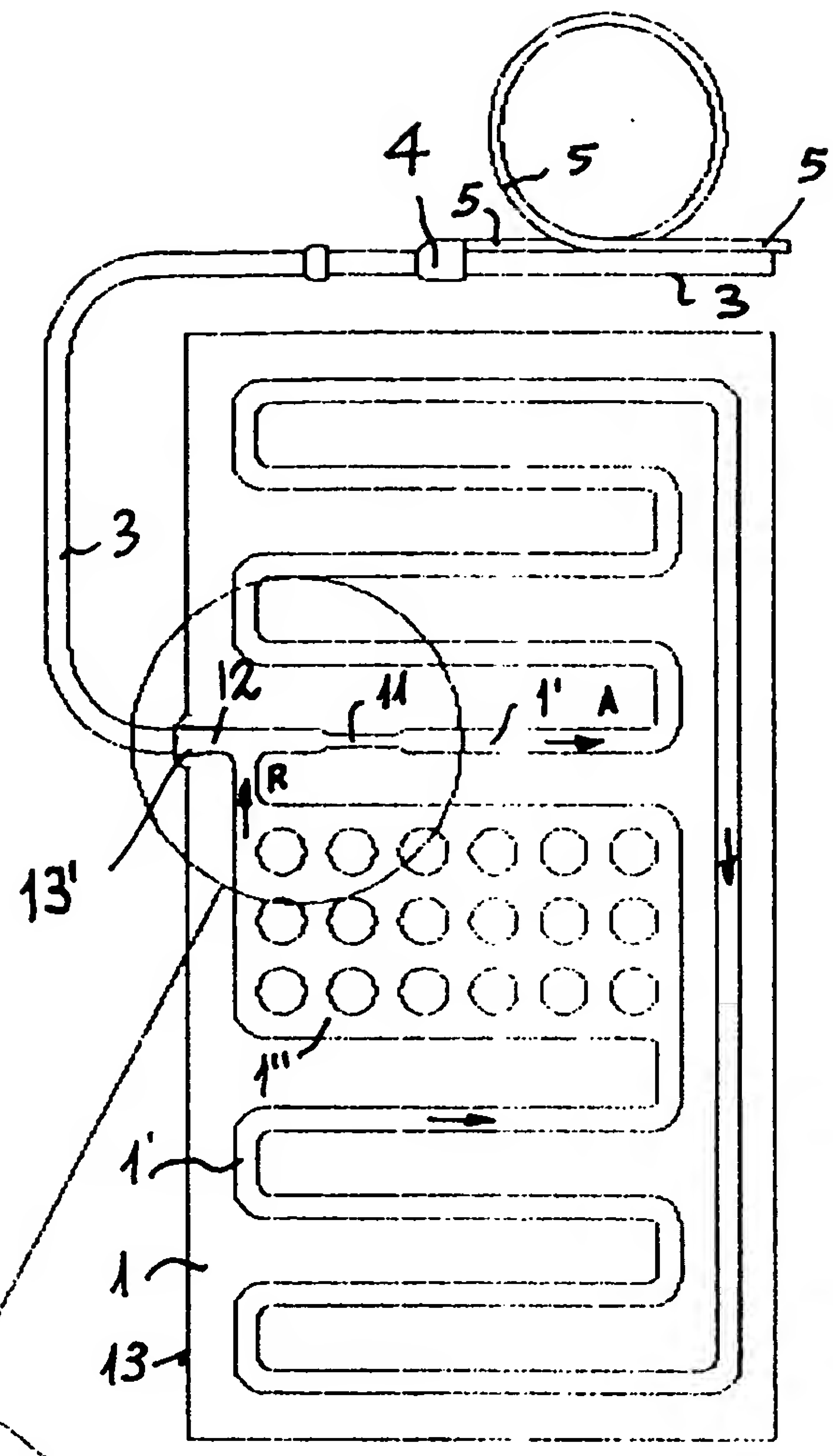

FIG. 1

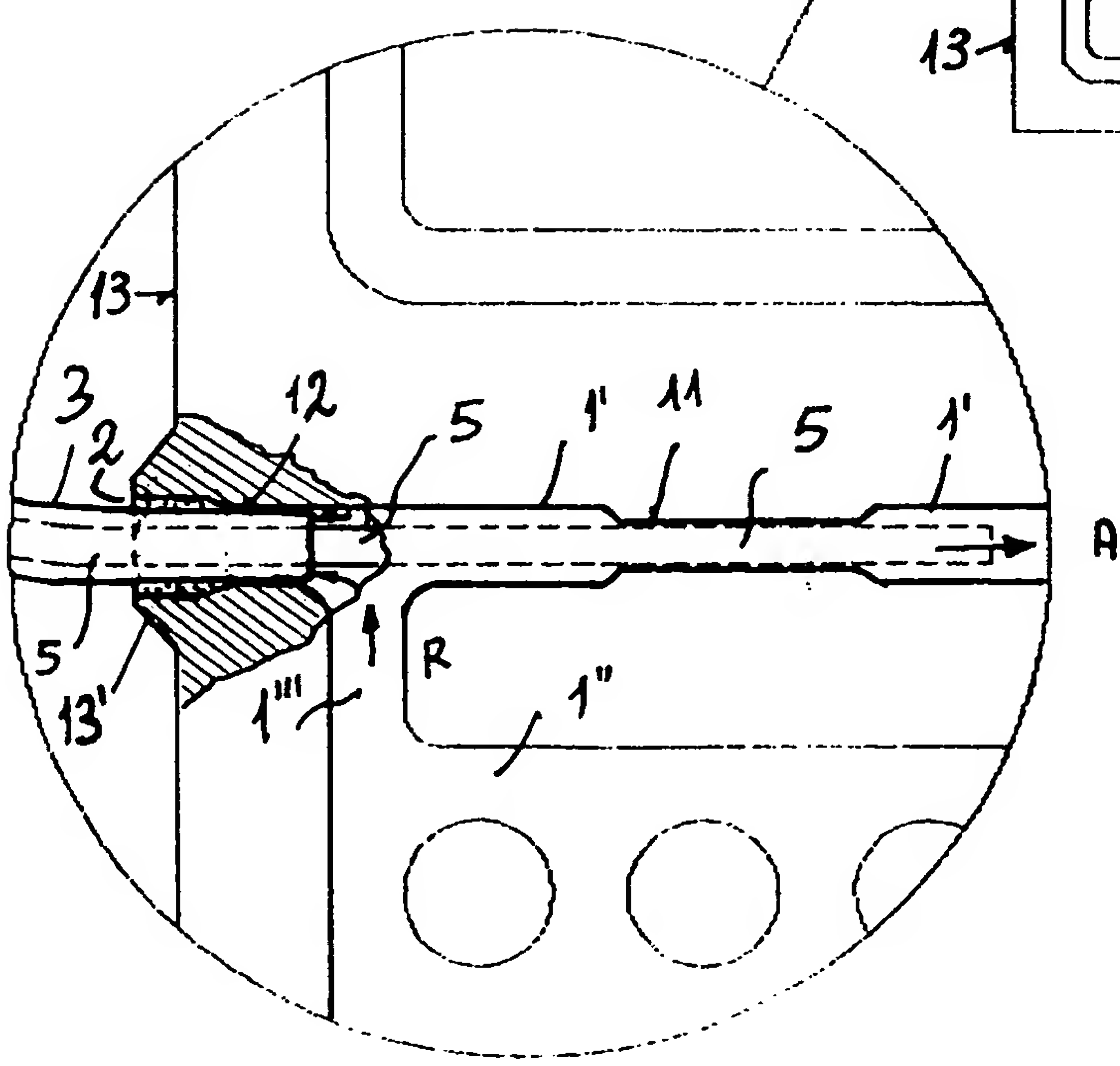

FIG. 2

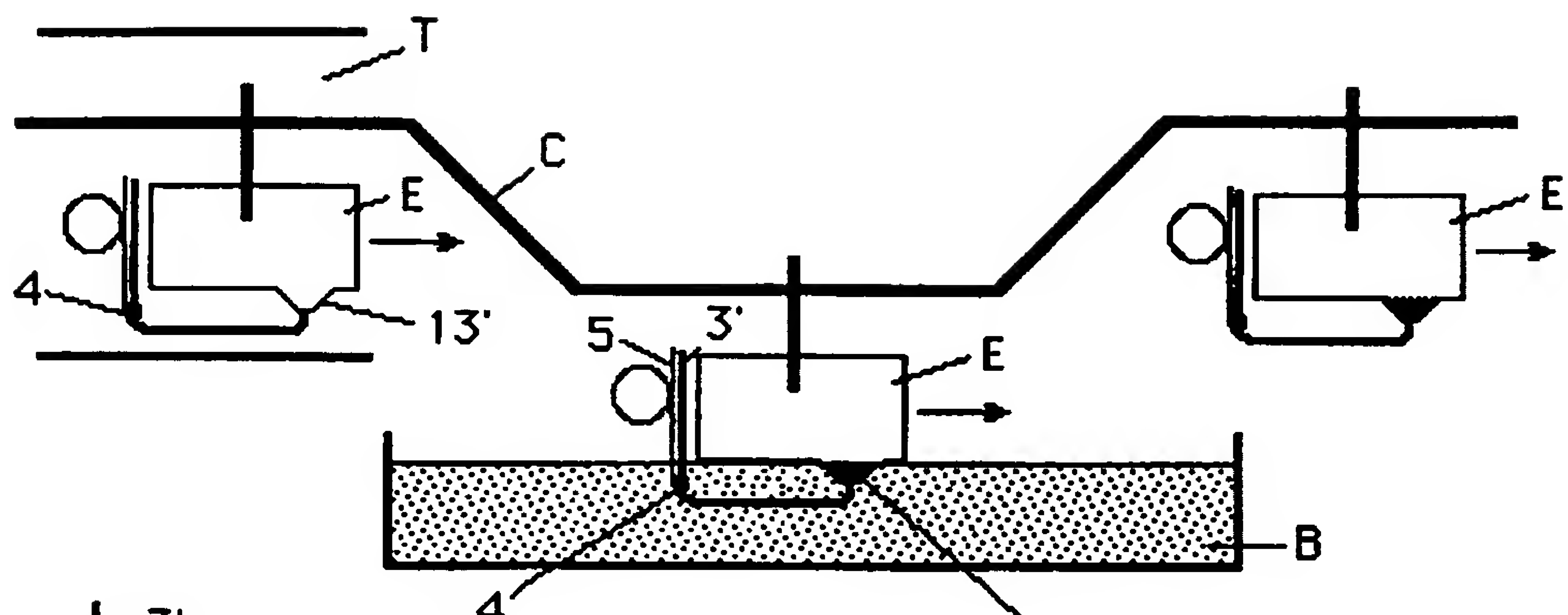

FIG.3

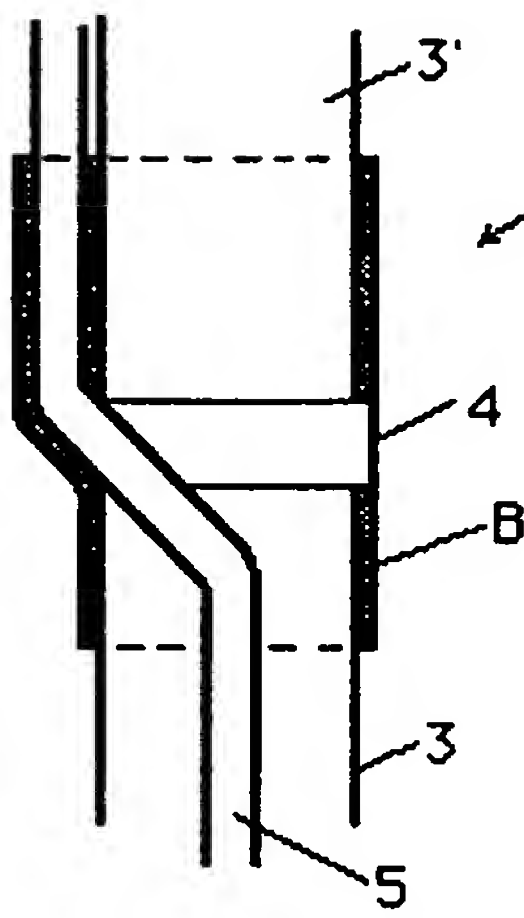

FIG.5

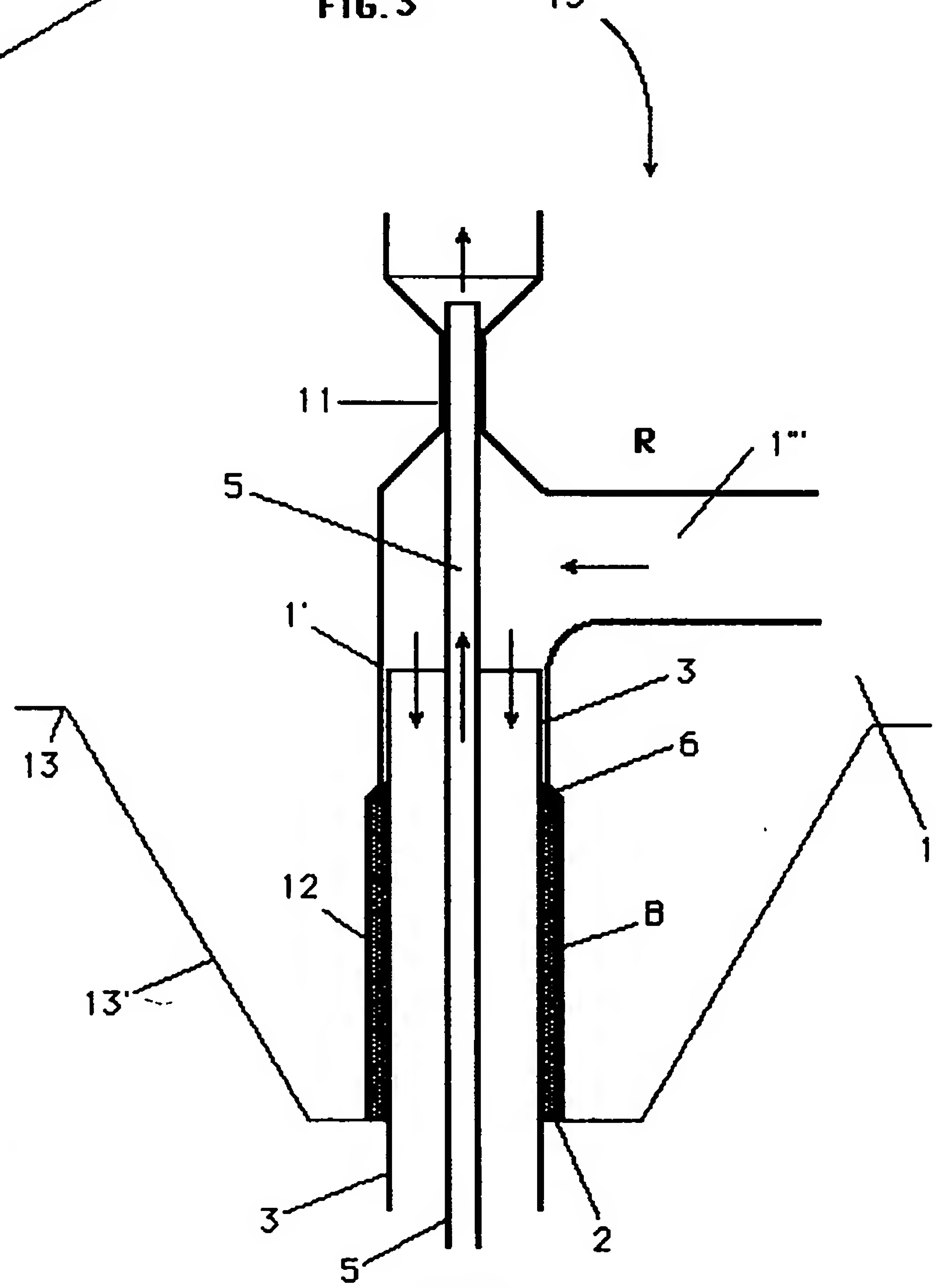

FIG.4

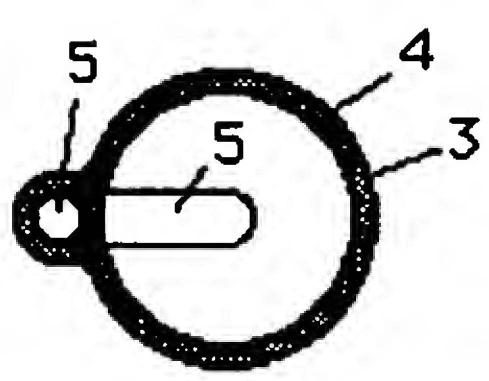

FIG.6

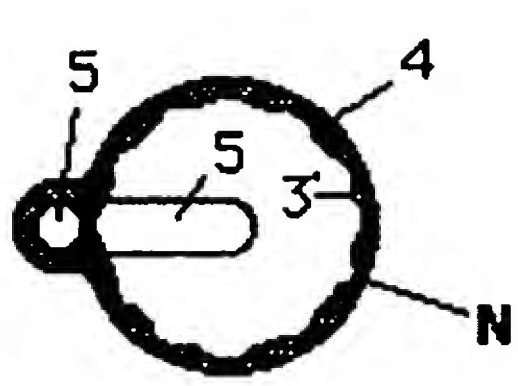

FIG.7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 10 9398

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 3 833 986 A (DECICCO)	1-3, 8-13, 15-21	B23P15/26 F25B39/02 B23K1/00 B23K3/06 B23K1/08
A	* column 1, line 5 - line 8; figures * * column 3, line 23 - column 5, line 12 * * column 2, line 49 - line 56 * ---	5,7,14, 23	
X	US 3 760 481 A (GREEVER)	1-3,9, 12,13, 15,18,19	
A	* column 3, line 19 - column 6, line 61; figures * ---	23	
X	US 3 920 176 A (BECKER ET AL)	1-3,6, 12,13, 15,19-21	
A	* column 3, line 33 - column 5, line 30; figures * ---	23	
X	US 5 101 889 A (POTIER) * figures * ---	1,6	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	US 5 269 158 A (BITTER ET AL) * column 4, line 6 - line 19; figures * ---	1,15, 23-31	B23P F25B B23K
A	DE 19 04 245 A (VEREINIGTE DEUTSCHE METALLWERKE AG) * claims 1,6; figures * ---	1,15, 23-31	
A	US 4 600 137 A (COMERFORD) * claims 1-3; figures * -----	4,22	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 April 1997	Plastiras, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document